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RISK FACTOR ANALYSIS AND PREVALENCE OF COCCIDIA IN SOWS AT BREEDING FARMS IN GIANYAR DISTRICT, BALI PROVINCE

Analisis Faktor Risiko dan Prevalensi Coccidia pada Induk Babi di Peternakan Pembibitan di Kabupaten Gianyar, Provinsi Bali

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Abstract

Coccidia, a protozoan parasite, can impede growth, reduce body weight, and even cause mortality in pigs. This study aimed to ascertain the prevalence and risk factors associated with coccidia infection in sows on pig breeding farms in Gianyar Regency. This observational study had a cross-sectional design. The sample consisted of 204 fecal specimens from sows across seven sub-districts in Gianyar Regency. Fecal samples were preserved in 2.5% potassium dichromate before examination using the salt-saturated flotation method. Prevalence data were analyzed descriptively, and logistic regression was used to identify risk factors. The findings revealed that 39.70% (81/204) of the sows were infected with coccidia, including *Eimeria* spp. (12.75%, 26/204), *Cystoisospora suis* (4.41%, 9/204), unsporulated oocysts (22.55%, 46/204), and dual infections with *Eimeria* spp. + *C. suis* (2.94%, 6/204). Farms with fewer than 100 pigs were 7.018 times more at risk than those with more than 100 pigs (p = 0.015; OR = 7.018). The source of water was also significantly associated with the use of well water (p = 0.023; OR = 0.097) and water from a regional water company (PDAM) (p = 0.012; OR = 0.127), which lowered the risk compared with spring water. Farmers who did not regularly disinfect their enclosures faced a risk 24.979 times greater than those who disinfected their enclosures daily (p = 0.020; OR = 24.979). Dry pigpen conditions (P = 0.003, OR = 0.052) were more protective than occasionally wet conditions. In conclusion, the prevalence of coccidia infection in breeding farms in Gianyar Regency was notably high. Factors associated with the prevalence of coccidia infection include pig population in the farm, water source, frequency of pen disinfection, and pen conditions.

Keywords: Coccidiosis, cross-sectional, *Cystoisospora suis*, *Eimeria* spp.

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Abstrak

Coccidia merupakan protozoa yang dapat menghambat pertumbuhan, penurunan bobot tubuh, bahkan kematian pada babi. Tujuan dari penelitian ini adalah untuk mengetahui prevalensi dan factor risiko yang berhubungan dengan infeksi *coccidia* pada induk babi di peternakan pembibitan di Kabupaten Gianyar. Penelitian ini merupakan penelitian observasional dengan rancangan *cross-sectional*. Sampel penelitian adalah 204 feses induk babi yang berasal dari tujuh kecamatan di Kabupaten Gianyar. Sampel feses disimpan pada kalium dikromat 2,5%, kemudian dilakukan pemeriksaan feses dengan metode pengapungan garam jenuh. Data prevalensi dijabarkan secara deskriptif, sedangkan untuk mengetahui faktor risiko digunakan uji regresi logistik. Hasil penelitian menunjukkan 39,70% (81/204) babi induk terdeteksi *coccidia* yang terdiri dari *Eimeria* spp. (12,75%, 26/204), *Cystoisospora suis* (4,41%, 9/204), ookista *unsporulated* (22,55%, 46/204) dan infeksi ganda *Eimeria* spp. dan *C. suis* (2,94%, 6/204). Peternakan yang memiliki populasi <100 ekor lebih berisiko 7.018 kali dari pada populasi >100 ekor (p = 0.015; OR = 7.018). Sumber air juga berhubungan signifikan, dengan penggunaan air sumur (p = 0.023; OR = 0.097) dan Perusahaan Daerah Air Minum (PDAM) (p = 0.012, OR = 0.127) menurunkan risiko dibandingkan penggunaan mata air. Peternak yang melakukan desinfeksi kandang tidak rutin memiliki risiko 24.979 kali dibandingkan dengan peternak yang melakukan desinfeksi setiap hari (p = 0.020; OR = 24.979). Kondisi kandang (p = 0.003, OR = 0.052) yang bersih dan kering cenderung lebih protektif dibandingkan dengan kandang yang kadang-kadang basah. Dapat disimpulkan bahwa prevalensi infeksi *coccidia* pada peternakan pembibitan di Kabupaten Gianyar cukup tinggi. Faktor yang berhubungan terhadap prevalensi infeksi *coccidia* adalah populasi peternakan, sumber air, intensitas desinfeksi kandang dan kondisi kandang.

Kata kunci: *Cross-sectional, Cystoisospora suis, Eimeria* spp., koksidiosis

INTRODUCTION

Pig farming constitutes a major livestock commodity in Gianyar Regency, with a total pig population of 85,579 (BPS, 2022). This sector provides substantial economic benefits and is a crucial source of income for the local community. However, inadequate farm management practices, particularly concerning hygiene and sanitation, can increase the prevalence of coccidia infection among pigs. Research indicates that factors such as floor type, hygiene, and manure management significantly influence the incidence of coccidia infection (Bawm et al., 2022). Coccidia are known to cause coccidiosis, which primarily manifests as diarrhea and can lead to considerable economic losses in the pig industry due to reduced weight gain and increased on-farm mortality (Han et al., 2025). Pigs with severe coccidia infections may exhibit clinical signs of diarrhea, which can be non-hemorrhagic and vary from paste-like to watery consistency (Joachim & Shrestha, 2019). This condition can severely compromise the immunity of piglets, rendering them more susceptible to other pathogenic infections caused by viruses, bacteria, and helminths (Agustianingsi et al., 2024; Han et al., 2025; Limarta et al., 2024).

Several factors have been identified as precipitants of coccidia infection. A primary factor is the type and cleanliness of the flooring; pigs housed on dirt or uncemented floors exhibit greater susceptibility than those housed on cemented or elevated floors (Bawm et al., 2022; Oba et al., 2023). Insufficient hygiene practices, such as infrequent manure removal and the absence of disinfectants, further elevate the risk of infection (Bawm et al., 2022; Roesel et al., 2017). Additionally, uncontrolled local feeding practices contribute to the increased intensity of coccidia infection (Bawm et al., 2022). From a management perspective, inadequate biosecurity measures and contact with external pigs increase the probability of infection

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(Bawm et al., 2022; Oba et al., 2023), with this risk exacerbated using residual feed and cohabitation of pigs of varying age groups within the same pen (Bisimwa et al., 2021). Age is also a significant determinant, with suckling piglets exhibiting higher infection rates than other age groups (Bawm et al., 2022; Gong et al., 2021; Nunes et al., 2023).

Coccidia infection in pigs has been extensively documented across various regions of Bali Province under diverse pig-rearing types and management practices (Agustina et al., 2016). At the Pesanggaran slaughterhouse in Denpasar, the prevalence of coccidia in pigs was 58.5% (113/200), with pigs originating from the districts of Badung, Bangli, Denpasar, and Karangasem (Apsari et al., 2023). Piglets sold in traditional markets within Bali Province exhibited a prevalence of *Eimeria* spp. of 54.8% from 250 fecal samples analyzed (Agustina et al., 2016). In the districts of Badung and Tabanan, the prevalence of *Eimeria* spp. was 78% (78/100) (Widisuputri et al., 2020). In the Jembrana district, the prevalence of *Eimeria* spp. infection was 90% (45/50), while that of *Cystoisospora suis* was 16% (8/50). In the Buleleng district, the prevalence of *Eimeria* spp. was 91% (61/67), with *C. suis* at 0% (0/67). In both districts, the infection severity was classified as severe, with oocytes per gram (OPG) exceeding 1550 (Pinatih et al., 2024). Furthermore, in Karangasem Regency, the prevalence was reported to be 44% (44/100) (Pratiwi et al., 2020). Despite extensive reporting on coccidia prevalence, research focusing on Gianyar Regency remains scarce. Additionally, the prevalence of coccidia in sows has not been documented. Sows in breeding farms infected with coccidia can transmit the infection to their offspring, primarily through oocyst excretion in feces (Hinney et al., 2021). These piglets are intended for use as breeding stock and are distributed to various regions across Bali.

Given that pig farming represents a significant livestock commodity in Gianyar Regency and considering that sows can transmit coccidiosis to their offspring, potentially facilitating its spread to other regions, it is imperative to ascertain the prevalence and associated risk factors. This study sought to determine the prevalence of coccidia infection in sows and identify risk factors, including the reproductive phase of the sows, pig population in the farm, and maintenance management practices. The data obtained are anticipated to inform guidelines for effective coccidiosis prevention and management in pig farming operations.

RESEARCH METHODS

Ethical Appropriateness of Experimental Animals

This study did not require ethical approval for the use of experimental animals, as it did not involve direct interaction with animals. Sample collection was conducted non-invasively, specifically through the collection of fecal matter from sows across all sub-districts within Gianyar Regency.

Object of Research

This study focused on sows in the lactation, pregnant, and dry phases across 17 farms located in seven districts within the Gianyar Regency. This study was conducted from December 2024 to February 2025. This study involved the collection of 204 fecal samples from individual sows. The samples were collected in plastic bags and treated with 2.5% potassium bichromate ($K_2Cr_2O_7$) until a homogeneous mixture was achieved. The samples were then stored at room temperature for seven days before examination.

Research Design

This study employed an observational, cross-sectional design to ascertain the prevalence of coccidia infection among breeding sows in Gianyar Regency, Bali. The sampling method utilized was purposive sampling, with specific criteria including sows in one of three phases:

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pregnant, lactating, or dry. Fresh and collectible fecal samples were required. Additionally, the sows were housed in stables, the farms included both sows and piglets, and the farm locations were situated within Gianyar Regency.

Research Variables

The independent variables in this study were the determination of risk factors, including sow phase (pregnant, dry, and lactating), pig population in the farm (<100 pigs and >100 pigs), feed source (purchased from store and self-produced), feed type (commercial feed and mixed feed), water source (spring, well, and regional water company (PDAM), pen cleaning frequency (once a day and twice a day), pen cleaning method (sprayed with flowing water and sprayed with water and shoveled), disinfection frequency (once a day, once a week, and not regularly), pen flooring type (concrete and metal grating), and pen floor condition bedding (dry and occasionally wet). The dependent variable was the prevalence of coccidia infection (*Eimeria* spp. and *C. suis)*. The controlled variables were sows in breeding farms in Gianyar Regency.

Data Collection Methods

Research data were collected through fecal examination utilizing the saturated salt flotation method, which is succinctly described as follows: fecal samples, previously stored for seven days in 2.5% potassium bichromate, were measured at 3 g, weighed, and placed into a glass beaker. Subsequently, 10 ml of water was added, and the mixture was homogenized. The homogenate was filtered using a sieve to eliminate large particles, and the filtrate was collected in a separate container. The filtrate was then transferred to a centrifuge tube to a volume of 10 ml and centrifuged at 1,500 rpm for 5 min. The supernatant was discarded, and the remaining precipitate was combined with the flotation solution until the original volume was restored, and homogenization was performed. The suspension was centrifuged again at the same speed for 5 min. The tube was carefully removed and positioned in a vertical position. The floating liquid was gradually added using a Pasteur pipette to form a convex meniscus. After a 10-minute interval, a cover glass was gently placed on the surface of the liquid and subsequently positioned on the object glass. The morphology of the coccidia oocysts was examined under a light microscope at 100-400x magnification to identify the morphology of coccidia oocysts (Zajac et al., 2021).

Data analysis

The prevalence of coccidia infection was determined by dividing the number of infected sows by the total number of sows observed and multiplying the result by 100%. Binary logistic regression analysis was employed to assess the risk factors associated with coccidia infections. The odds ratio (OR) was used to quantify the strength of the association between independent variables and infection status. A p-value of less than 0.05 was considered statistically significant. All analyses were conducted using SPSS version 26 (Merga & Sibhat, 2015).

RESULTS AND DISCUSSION

Results

A total of 204 fecal samples from sows were collected from 17 farms across seven sub-districts in Gianyar Regency, Bali, Indonesia. The distribution of samples across the sub-districts was as follows: Blahbatuh (13), Gianyar (5), Sukawati (27), Payangan (67), Tegallalang (82), Tampaksiring (10), and Ubud (6). The samples comprised 98 pregnant sows, 53 lactating sows, and 55 dry sows. The analysis revealed that 39.70% (81/204) of the samples tested positive for coccidia. Specifically, 12.75% (26/204) were positive for *Eimeria* spp., 4.41% (9/204) for *C. suis*, 22.55% (46/204) contained oocysts that had not yet sporulated, and 2.94% (6/204) exhibited double infections with both *Eimeria* spp. and *C. suis* (Figures 1 and 2).

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Concerning the reproductive phase of the sows, 39.58% (38/96) tested positive during pregnancy, 37.74% (20/53) during lactation, and 41.82% (23/55) during the dry phase. The findings regarding the diversity of coccidia infection among sows in Gianyar Regency indicated that the majority of the oocysts had not sporulated, particularly in pregnant sows (22.92%, 22/96) and dry sows (23.64%, 13/55) (Table 1).

Logistic regression analysis results indicated that four variables were significantly associated ($p<0.05$) with the incidence of coccidia infection in breeding farms in Gianyar Regency. These variables included the pig population in the farm, intensity of pen disinfection, water source, and pen condition. Specifically, farms with a population of fewer than 100 pigs exhibited a 7.018 times greater risk of coccidia infection than those with a population exceeding 100 pigs ($p = 0.015$, OR = 7.018). Water sources from springs had the lowest prevalence of coccidia compared to wells and PDAM. However, after logistic regression analysis, farms using water from wells or PDAM had a 90.3% (OR = 0.097; $p = 0.023$) and 87.3% (OR = 0.127; $p = 0.012$) lower risk of coccidia infection, respectively, compared to those using spring water. The intensity of pen disinfection was significantly associated with infection risk ($p = 0.020$, OR = 24.979), as farms that did not regularly disinfect their pen had a 24.979 times higher risk of infection than those that disinfected once daily. Furthermore, pen conditions significantly influenced infection incidence ($p = 0.003$, OR = 0.052), with dry pens providing 94.8% more protection than occasionally wet pens. Other variables, such as the sow phase, source and type of feed, frequency, method of pen cleaning, and type of pen flooring, did not exhibit a statistically significant association with infection incidence ($p> 0.05$) (Table 2).

Discussion

Prevalence of Coccidia in Sows in Gianyar Regency

The prevalence of coccidia infection among sows in breeding farms within Gianyar Regency was 39.70% (81/204). This prevalence is notably lower than that reported in previous studies in Bali Province. For instance, Agustina et al. (2016) reported a prevalence of 54.8% among piglets sold in traditional markets in the Bali Province. Similarly, Pratiwi et al. (2020) documented a prevalence of 46.5% in the highland regions of Bali Province, specifically Karangasem and Buleleng. Apsari et al. (2023) found a prevalence of 58.5% in the Pesanggaran Slaughterhouse, Denpasar. Furthermore, Widisuputri et al. (2020) reported a prevalence of 78% in the Badung and Tabanan districts, while Pinatih et al. (2024) observed a prevalence of 90.5% for *Eimeria* spp. in the Jembrana and Buleleng districts.

The prevalence of coccidiosis in pigs varies due to a multitude of factors, including geographical location, farming system, animal age, seasonal and temperature variations, hygiene conditions, and farm management practices. Notable differences in prevalence have been documented in regions such as northwest China (Gong et al., 2021) and various areas in Brazil (Sperling et al., 2022). Extensive farming systems exhibit a higher prevalence than intensive systems (de Araújo et al., 2020a; Gong et al., 2021). Age is also a significant factor, with the highest prevalence occurring in pigs during the finishing and suckling phases (Gong et al., 2021; Zhang et al., 2012). Environmental factors, including temperature and seasonality, further contribute to increased prevalence (de Araújo et al., 2020a; Sperling et al., 2022). Although the administration of toltrazuril has been shown to mitigate infection, it does not completely eradicate the parasite (Hinney et al., 2021; Sperling et al., 2020), and ineffective disinfection practices remain a concern ((Hinney et al., 2021)). Good management practices can improve pig health and reduce the prevalence of diseases (de Araújo et al., 2020b).

Environmental factors significantly contribute to the prevalence of parasitic infections, such as coccidiosis, which are heavily influenced by pen cleanliness and thorough disinfection

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practices. Suboptimal cleaning and disinfection of pens create conditions conducive to the proliferation of coccidia. Additionally, oocyst contamination of feed and water sources is the primary transmission route for the disease (Das et al., 2019). In Gianyar District, the practice of mixing finished feed with household food waste persists, potentially serving as a transmission medium. Sows in this region are typically housed semi-intensively in pens, although management practices vary among the farmers. Farms with smaller pig populations often exhibit poorer management, characterized by irregular disinfection, damp housing conditions, and inadequate water sources, thereby fostering an environment conducive to parasite proliferation and increasing the risk of exposure in sows. Furthermore, low hygiene standards and insufficient husbandry management practices contribute to elevated coccidiosis infection rates (Karamon et al., 2007). Although most farmers in Gianyar clean their pens at least once daily, inconsistent disinfection practices and inadequate fecal waste management remain factors that may elevate the risk of coccidiosis in breeding farms.

Analysis of the study results revealed that 12.75% of sows were infected with *Eimeria* spp., 4.41% with *C. suis* 22.55% exhibited the presence of non-corporatized oocysts, and 2.94% experienced co-infection with both *Eimeria* spp. and *C. suis*. Overall, the prevalence of *C. suis* was lower than that of *Eimeria* spp., which may be attributed to the number of species within each genus. According to Pinatih et al. (2024), the prevalence of *Eimeria* spp. was 90.5%, while that of *Isospora suis* was 6.8% in Buleleng and Jembrana. Furthermore, in China, *C. suis* exhibited the highest prevalence at 8.13% (268/3296), followed by eight other *Eimeria* species. However, when these eight species were combined, the overall prevalence of *Eimeria* was higher (Wang et al., 2025).

The detection of coccidia that have not yet sporulated can be caused by sporulation failure. Sporulation failure of *Eimeria* oocysts in potassium bichromate ($K_2Cr_2O_7$) media can be caused by several factors. The concentration of potassium bichromate has a direct influence on sporulation time and success, with incubation in 1% to 10% $K_2Cr_2O_7$ solution allowing sporulation in approximately 28 hours, while lower or higher concentrations of chromium prolong this process (M.-H. Li & Ooi, 2008). In addition, microorganisms in the fecal suspension can reduce oocyst survival, as shown by the greater number of oocysts found in the oxidation medium (2% $K_2Cr_2O_7$) than in the fecal suspension, suggesting an inhibitory effect of microbes (Lassen & Seppä-Lassila, 2014). Environmental temperature is also an important variable; low temperatures, such as 18°C, slow sporulation, whereas higher temperatures, such as 28°C, accelerate the process (Pyziel & Demiaszkiewicz, 2015). However, extreme temperatures, such as freezing at -18°C, have been shown to significantly reduce oocyst viability, although some Eimeria species can still sporulate post-freezing (Lassen & Seppä-Lassila, 2014). Eimeria oocyst sporulation is highly dependent on the presence of oxygen, especially when cultured in potassium dichromate ($K_2Cr_2O_7$) medium. Oxygen is an essential component for effective sporulation. Under experimental conditions, unsporulated oocysts are usually exposed to potassium dichromate with partial exposure to oxygen, such as by partially covering the Petri dish to ensure adequate oxygen circulation during incubation. In addition, controlled temperature and humidity are used to support an optimal sporulation environment (Abbas et al., 2015). Therefore, sporulation failure in potassium bichromate is most likely a result of a combination of improper compound concentration, suboptimal incubation temperature, microbial contamination, lack of oxygen exposure under experimental conditions, or exposure to other inhibitory chemicals.

Pig Population in the Farm Factors

The prevalence of coccidia infection in sows on breeding farms in Gianyar Regency was influenced by the pig population in the farm. Specifically, farms with fewer than 100 pigs were

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7.018 times more likely to experience coccidia infection than those with populations exceeding 100 pigs. Observations indicate that farms in Gianyar Regency with more than 100 pigs typically employ superior management practices. Conversely, farms with fewer than 100 pigs generally demonstrate simpler management practices, which are often characterized by suboptimal biosecurity and disinfection measures, poor pen hygiene, and inadequate pen infrastructure. The incidence of intestinal parasite infections also varies with farm size; small- and medium-sized farms tend to exhibit higher infection rates than larger farms, particularly if they do not implement an all-in/all-out system or utilize litter and paddock floors (Kochanowski et al., 2017).

The prevalence of coccidia in small-scale pig farms is notably high and is influenced by various management, environmental, and socioeconomic factors. Inadequate biosecurity measures and substandard sanitation practices on these farms facilitate the extensive dissemination of coccidia (Milićević et al., 2023). This situation is exacerbated by irregular manure management and ineffective application of disinfectants ((Nunes et al., 2023; Roesel et al., 2017). High population density within confined spaces promotes parasite transmission through direct contact and environmental contamination (Barbosa et al., 2015; Gong et al., 2021). Furthermore, elevated room temperatures, commonly observed in small facilities, increase the risk of infection by 23.2% for each one-degree Celsius rise in temperature (Sperling et al., 2022). Unregulated swill feeding practices also contribute to contamination (Milićević et al., 2023), whereas inconsistent or untimely administration of antiparasitic drugs renders coccidia control ineffective (Nunes et al., 2023). Socioeconomic factors, such as the low income and education levels of farm managers, are correlated with high parasite prevalence (Chaudhary et al., 2023). Consequently, implementing improved management practices, enhanced sanitation, farmer education, and regular monitoring is crucial for mitigating coccidia infection rates in small-scale pig farms.

Water Source Factors

Water source was a risk factor for coccidia infection in sows. Although the apparent prevalence of infection was higher in farms using wells (41.667%) and PDAM water (48.936%), logistic regression analysis showed that, after controlling for other factors, spring water (34.021%) had the highest risk of infection. With OR < 1 and significant p-value, using water from wells and PDAM significantly reduced the risk of infection compared to springs. Farms using wells had a 90.3% lower risk of coccidia infection (OR = 0.097, p = 0.023) compared to those using spring water. Farms using water from PDAM had an 87.3% lower risk of coccidia infection (OR = 0.127, p = 0.012) compared to those using spring water.

Water quality exerts an indirect yet significant influence on coccidia infection in pigs by affecting the animal's health and immune system. Contaminated water containing bacteria, endotoxins, and coliforms can deteriorate the health of pigs and compromise their immune defenses, thereby increasing their susceptibility to coccidiosis (Böger et al., 2020). Furthermore, contamination of water sources by animal feces, including those from feral pigs harboring pathogens such as *Salmonella* spp., *Campylobacter* spp., and *Escherichia coli*, can elevate the pathogen load in the environment and degrade water quality (Bradley et al., 2025; Brooks et al., 2020). Although direct evidence linking water quality to coccidia infection is lacking, the high prevalence of coccidia in pigs raised in open environments suggests that environmental factors are crucial (Eijck & Borgsteede, 2005). Consequently, effective water management practices, including disinfection with sodium hypochlorite, are vital for reducing pathogen loads in water and preventing secondary infections, such as coccidiosis (Lozinski et al., 2022).

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Disinfection Intensity Factor

Farms that implemented daily pen disinfection exhibited a lower prevalence of infection than those that practiced weekly or nonroutine disinfection. Specifically, farms that did not engage in routine disinfection were 24,979 times more likely to be infected with coccidia than those disinfected daily. Non-routine disinfection has been identified as a factor contributing to the increased prevalence of coccidia in pig farms. A study conducted in Portugal revealed that none of the farms utilized disinfectants with official claims against parasites, resulting in a persistently high prevalence of *C. suis* (Nunes et al., 2023). In Europe, only two farms employed disinfectants effective against coccidia, and these farms reported no cases of *C. suis* (Hinney et al., 2020). Research in Austria corroborated that farms with inadequate hygiene and no disinfection practices face a higher risk of diarrhea and oocyst excretion (Kreiner et al., 2011). Similarly, farms in Belgium and the Netherlands that utilized effective disinfectants reported no oocyst excretion (Hinney et al., 2021). Extensive livestock systems and outdoor farms generally exhibit a higher prevalence of coccidia, likely due to variations in hygiene and disinfection practices (Eijck & Borgsteede, 2005; Gong et al., 2021). Even with the administration of toltrazuril, the absence of effective disinfection results in a high incidence of *C. suis* infection, indicating that treatment alone is insufficient to control coccidiosis (Hinney et al., 2020, Hinney et al., 2021; Sperling et al., 2020). Consequently, routine and proper disinfection practices are crucial for reducing the prevalence of coccidia on pig farms.

Ineffective disinfectant use or no disinfectant use, especially disinfectants such as chlorocresol that have been shown to be effective but are rarely used, exacerbates the spread of infection and results in persistent infection (Hinney et al., 2020, Hinney et al., 2021; Nunes et al., 2023). Many farms use disinfectants that are ineffective against coccidia. For example, disinfectants containing oxygen-releasing agents or glutaraldehyde + ammonia are ineffective against coccidia (Hinney et al., 2020, Hinney et al., 2021). Based on our observations, in Gianyar Regency, most farmers use disinfectants with active ingredients such as chlorine, formaldehyde, and their derivatives intended for disinfection against viral, bacterial, and fungal diseases. However, this routine disinfection pattern may be related to good sanitation management, thus affecting the reduction in coccidia prevalence.

Pen Condition Factor

Farms with intermittently wet enclosures exhibited a higher prevalence of issues than those with dry conditions. Enclosures that were maintained in a dry state were approximately 94.8% more effective. Moisture in pig barns can substantially elevate environmental humidity within the facility. Water on the floor or other surfaces facilitates evaporation, thereby increasing the water vapor content in the air and consequently increasing the relative humidity level (Li et al., 2019; Xie et al., 2014).

A moist and warm environment is optimal for oocyst sporulation. Environmental factors external to the host, such as temperature, humidity, and the availability of sufficient oxygen, significantly influence coccidia infection. Oocysts achieve sporulation, reaching the infective stage at an optimal temperature of up to 29°C (Pratiwi et al., 2020). High humidity enhances the stability and durability of *C. suis* oocysts in the environment, thereby increasing the likelihood of infection in pigs (De et al., 2021; Radhika et al., 2017). Research conducted in China indicated that the prevalence of coccidia infection in suckling piglets escalated under humid environmental conditions (Zhang et al., 2012), while a study in Portugal corroborated that a wet and poorly managed environment contributed to the high prevalence of *C. suis* (Nunes et al., 2023). Conversely, dry housing conditions can impede the development of coccidia. The reduction of moisture and maintenance of hygiene are crucial for controlling the

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spread of coccidia (Hinney et al., 2021; Nunes et al., 2023). Dry environmental conditions can diminish the survival and dissemination of coccidia oocysts, as moisture is the primary factor facilitating sporulation and transmission (Hinney et al., 2021).

CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on the findings of the present study, it can be concluded that the prevalence of coccidia infection among sows in breeding farms within Gianyar Regency was notably high at 39.7%. This prevalence comprised *Eimeria* spp. (12.75%), *Cystoisospora suis* (4.41%), oocysts that had not yet sporulated (22.55%), and dual infections of *Eimeria* spp. and *C. suis* (2.94%). The risk factors associated with the prevalence of coccidia infection include the pig population in the farm, the water source, the frequency of pen disinfection, and the pen conditions. The factors found to be unrelated included the sow phase, source of feed, type of feed, frequency of pen cleaning, method of pen cleaning, and type of pen floor.

Suggestions

To mitigate the incidence of infections, pig breeding farms in Gianyar Regency should prioritize the evaluation and enhancement of water quality. It is recommended that disinfection procedures be intensified as a daily routine to prevent coccidiosis. Additionally, farmers should maintain cleanliness and dryness in animal enclosures. A thorough investigation of management practices on farms with smaller populations that exhibit higher prevalence rates is warranted. Future research should focus on assessing the efficacy of various treatment protocols, considering prevalence rates and associated risk factors.

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Table

Table 1. Diversity of coccidia infection in sows in Gianyar Regency

Type of Coccidia	Positive Samples (n)			Prevalence (%)		
	Pregnant Sows (n=38)	Lactating Sows (n=20)	Dry Sows (n=23)	Pregnant Sows (39,58)	Lactating Sows (37,74)	Dry Sows (41,82)
Eimeria sp	8	10	8	8,33	18,87	14,54
Cystoisospora suis	4	4	1	4,17	7,55	1,82
Unsporulated oocyst	22	5	13	22,91	9,43	23,64
Eimeria spp. + *C. suis*	4	1	1	4,17	1,89	1,82

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Table 2. Risk factors for coccidia infection in sows in breeding farms in Gianyar Regency.

Risk Factor	Risk Factor Category	Total sample	Positive	Prevalence (%)	p-value	Odds ratio
Pig Population in the Farm	< 100 pigs	86	44	51,163	0,015*	7,018
	> 100 pigs	118	37	31,356		
Sow Stage	Pregnant	96	38	39,583	0,956	
	Lactating	53	20	37,736	0,797	1,104
	Dry	55	23	41,818	0,965	0,983
Feed Source	Purchased from Store	159	65	40,881	0,155	0,302
	Self-produced	45	16	35,556		
Feed Type	Commercial Feed	58	25	43,103	0,273	0,468
	Mixed Feed	146	56	38,356		
Water Source	Spring	97	33	34,021	0,037*	
	Well	60	25	41,667	0,023*	0,097
	Regional Water Company	47	23	48,936	0,012*	0,127
Pen Cleaning Frequency	Once Daily	23	14	60,870	0,391	0,333
	Twice Daily	181	67	37,017		
Pen Cleaning Method	Sprayed with Flowing Water	76	26	34,211	0,178	0,323
	Sprayed and Shoveled	128	55	42,969		
Disinfection Frequency	Daily	101	38	37,624	0,020*	
	Weekly	82	33	40,244	0,253	2,549
	Not Regular	21	10	47,619	0,005*	24,979
Pen Flooring Type	Concrete	150	65	43,333	0,366	0,557
	Metal Grating	54	16	29,630		
Pen Floor Condition	Dry	125	48	38,400	0,003*	0,052
	Occasionally Wet	79	33	41,772		

Figure

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Figure 1. Identification of coccidia in sows (A) Unsporulated oocysts (B) *Cystoisospora suis* (C) *Eimeria* spp.

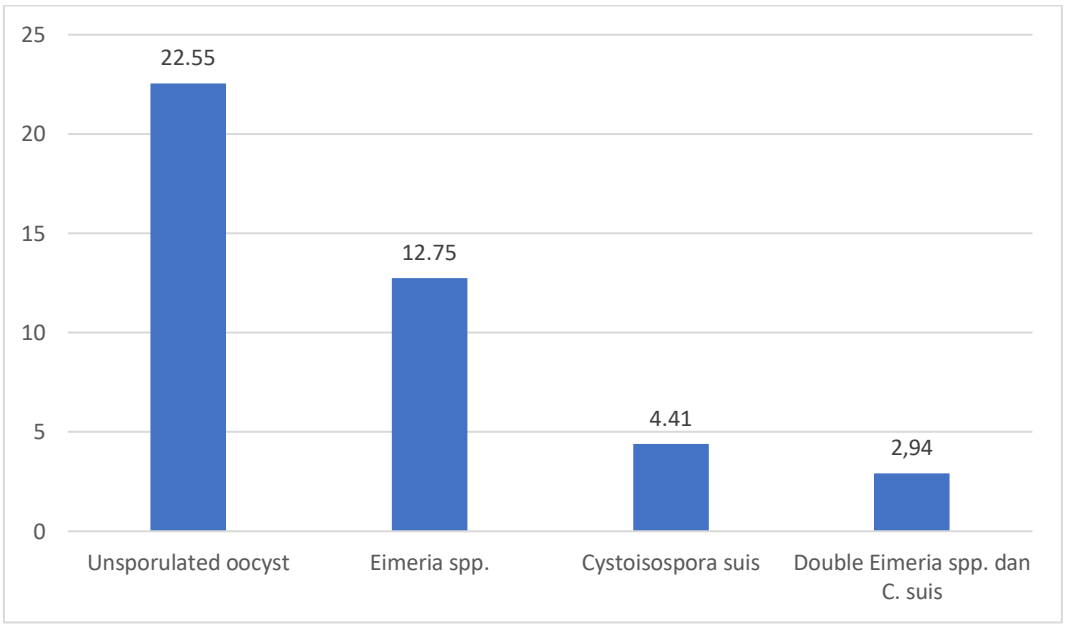

Figure 2. Histogram of the prevalence of coccidia infection in sows in breeding farms in Gianyar Regency

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